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PATENT ABSTRACTS OF JAPAN

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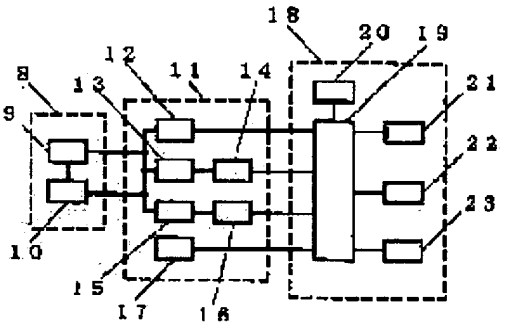
(54) BLOOD PRESSURE MEASURING DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To eliminate a troublesome manipulation at measuring the blood pressure and enhance the easiness in handling the device by arranging it so that the blood pressure is calculated on the basis of the pulsation signal obtained through sensing, and therefore, only one sensor, a pulsation sensor, must be put on the body of a subject.

SOLUTION: A blood pressure measuring device senses the pulsation generated by blood circulation in a human body using a pulsation sensing means 8, calculates the feature amount related to the blood pressure using a feature amount calculating means 11 on the basis of the pulsation signal obtained through sensing, and calculates the blood pressure using a blood pressure calculating means 18 on the basis of the obtained feature amount. According to this configuration where the blood pressure is determined on the basis of pulsation signals, only one sensor, a pulsation sensor, must be put on the body of a subject to lead to elimination of troublesomeness in manipulation at measuring the blood pressure and enhancement of the easiness in handling the device, and further because the blood pressure measurement is conducted through computation of the feature amount related to the blood pressure, accurate measurements can be obtained even with varying shape of pulsation.



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*NOTICES *

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2.**** shows the word which can not be translated.
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CLAIMS

[Claim(s)]
[Claim 1] Blood-pressure-measurement equipment which consists of a pulse wave detection means to detect the pulse wave produced by the blood circulation of a human body, a characteristic quantity operation means to calculate the characteristic quantity relevant to blood pressure based on the pulse wave signal outputted from the aforementioned pulse wave detection means, and a blood-pressure operation means to calculate blood pressure based on the characteristic quantity signal outputted from the aforementioned characteristic quantity operation means.
[Claim 2] A pulse wave detection means is blood-pressure-measurement equipment according to claim 1 with [at the aforementioned pulse wave interval / calculate a pulse wave interval and] the amendment pulse wave amendment section for the pulse wave signal.
[Claim 3] A characteristic quantity operation means is blood-pressure-measurement equipment according to claim 1 or 2 with each wave height of the pulse wave signal outputted from a pulse wave detection means, the ratio of each aforementioned wave height, the time from a pulse wave standup point to each aforementioned wave, the time interval between each aforementioned wave, the integration value of a pulse wave, and the pulse wave characteristic quantity operation part that calculates at least one of the pulse rates as pulse wave characteristic quantity.
[Claim 4] Blood-pressure-measurement equipment of the claim 1 or the any 1 term publication of three characterized by providing the following A characteristic quantity operation means is speed pulse wave operation part which calculates the speed pulse wave which is the primary differential of a pulse wave based on the pulse wave signal outputted from a pulse wave detection means. Speed pulse wave characteristic quantity operation part which calculates at least one of each wave height of the speed pulse wave signal outputted from the aforementioned speed pulse wave operation part, the ratio of each aforementioned wave height, the time from the speed pulse wave standup point describing above to each aforementioned wave, the time interval between each aforementioned wave, and the zero cross intervals of the aforementioned speed pulse wave as speed pulse wave characteristic quantity
[Claim 5] Blood-pressure-measurement equipment of the claim 1 or the any 1 term publication of four characterized by providing the following A characteristic quantity operation means is acceleration pulse wave operation part which calculates the acceleration pulse wave which is the secondary differential of a pulse wave based on the pulse wave signal outputted from a pulse wave detection means. Acceleration pulse wave characteristic quantity operation part which calculates at least one of each wave height of the acceleration pulse wave signal outputted from the aforementioned acceleration pulse wave operation part, the ratio of each aforementioned wave height, and the time intervals between each aforementioned wave as acceleration pulse wave characteristic quantity
[Claim 6] They are the claim 1 with the pulse wave propagation characteristic quantity operation part to which a pulse wave detection means has two or more pulse wave detecting elements which detect the pulse wave of the part to which a human body is different from each other, and a characteristic quantity operation means calculates at least one of the pulse wave propagation time and the pulse wave propagation velocity as pulse wave propagation characteristic quantity based on the pulse wave signal from the aforementioned pulse wave detecting element, or blood-pressure-measurement equipment of five given in any 1 term.
[Claim 7] A characteristic quantity operation means is the height of a human body, weight, sex, the claim 1 with [using at least one of the age as body characteristic quantity] the body characteristic quantity input section which can be inputted, or blood-pressure-measurement equipment of six given in any 1 term.
[Claim 8] A blood-pressure operation means is the claim 3 which calculates blood pressure based on at least one of pulse wave characteristic quantity, speed pulse wave characteristic quantity, acceleration pulse wave characteristic quantity, pulse wave propagation characteristic quantity, and the body characteristic quantity, or blood-pressure-measurement equipment of seven given in any 1 term.
[Claim 9] A blood-pressure operation means is the claim 3 which has the reference-value input section which can input

the reference value of blood pressure, and can amend the relation between at least one of pulse wave characteristic quantity, speed pulse wave characteristic quantity, acceleration pulse wave characteristic quantity, pulse wave propagation characteristic quantity, and the body characteristic quantity, and the blood pressure to calculate, or blood-pressure-measurement equipment of eight given in any 1 term.

[Claim 10] A blood-pressure value operation means is the claim 3 which makes the reference value of blood pressure a teacher signal, and learns the relation between at least one of pulse wave characteristic quantity, speed pulse wave characteristic quantity, acceleration pulse wave characteristic quantity, pulse wave propagation characteristic quantity, and the body characteristic quantity, and the blood pressure to calculate, or blood-pressure-measurement equipment of nine given in any 1 term.

[Claim 11] A pulse wave detection means is the claim 1 which can equip at least one part of the fingertip of a hand, an earlobe, the fingertip of a leg, an overarm, a wrist, the neck, and a thorax, and detects the pulse wave of the aforementioned part, or blood-pressure-measurement equipment of ten given in any 1 term.

[Claim 12] A pulse wave detection means is blood-pressure-measurement equipment according to claim 11 which has the 2nd pulse wave detecting element which adjoins the 1st pulse wave detecting element which detects a pulse wave, and the 1st pulse wave detecting element, is installed from the fingertip of a hand, and detects a pulse wave from parts other than the aforementioned fingertip.

[Claim 13] It is blood-pressure-measurement equipment according to claim 12 with which the 1st pulse wave detecting element and the 2nd pulse wave detecting element have the light-emitting part and light sensing portion for a photoelectrical pulse wave method detecting a pulse wave, respectively, and both light-emitting parts were shared.

[Claim 14] The 2nd pulse wave detecting element is blood-pressure-measurement equipment according to claim 12 which consists of a pressure sensor which detects pulse pressure.

[Claim 15] The 2nd pulse wave detecting element is blood-pressure-measurement equipment according to claim 12 which consists of a microphone which detects a heartbeat.

[Claim 16] A blood-pressure value operation means is the claim 1 with the storage section which memorizes the calculated blood pressure, or blood-pressure-measurement equipment of 15 given in any 1 term.

[Claim 17] A blood-pressure value operation means is the claim 1 with the display which displays the calculated blood pressure, or blood-pressure-measurement equipment of 15 given in any 1 term.

[Claim 18] A blood-pressure value operation means is the claim 1 with the alarm generating section which generates an alarm when it deviates from the normal range to which the calculated blood pressure was set beforehand, or blood-pressure-measurement equipment of 15 given in any 1 term.

[Claim 19] A blood-pressure value operation means is the claim 1 with the terminal area for communication for performing communication with an external medium, or blood-pressure-measurement equipment of 15 given in any 1 term.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the blood-pressure-measurement equipment of a low restraint which measures blood pressure without using especially a cuff (tourniquet) about blood-pressure-measurement equipment.
[0002]
[Description of the Prior Art] As for this conventional kind of blood-pressure-measurement equipment of a low restraint, what is indicated by JP,8-140948,A was common. As shown in drawing 25 , this blood-pressure-measurement equipment The electrocardio grade electrodes 1 and 2, An electrocardio grade signal The electrocardio processing means 3 and the finger-tip photoelectrical pulse wave sensor 4 to process, and a pulse wave signal It consists of a pulse wave processing means 5 to process, secondary differential meanses 6 to differentiate a pulse wave signal the 2nd order, an operation means 7 to calculate blood pressure based on the electrocardio grade signal and pulse wave signal by which signal processing was carried out, and secondary differential signals of a pulse wave, and a display means 8 to display the result of an operation. Each part grade of a human body is equipped with the electrocardio grade electrodes 1 and 2 and the finger-tip photoelectrical pulse wave sensor 4 like drawing 25 .
[0003] And as shown in drawing 26 , while asking for the pulse wave propagation time PTT, the pulse wave interval PI, and a heart rate HR (=1/PI) from an electrocardio grade wave and a pattern of pulse wave, the above-mentioned operation means 7 It considers as Parameter TP. the ratio of the 1st wave height x of the right direction of the secondary differential wave of a pulse wave, and the 1st wave height y of the negative direction -- the time difference Tb of y/x or the 1st peak of the right direction of a pulse wave, and the 2nd peak of the right direction -- asking -- this -- a vessel -- a character -- based on a formula (1), a blood-pressure value (highest blood pressure (SYS), lowest blood pressure (DIA)) is calculated -- it was like like
[0004]
SYS, DIA=c1*HR+c2*PTT+c3*TP+c4 Formula (1)
However, c1, c2, c3, and c4 are the constants obtained statistically, and they differ by SYS and DIA, respectively.
[0005]
[Problem(s) to be Solved by the Invention] However, with the above-mentioned conventional blood-pressure-measurement equipment, since the pulse wave propagation time had to be found in order to calculate blood pressure, the human body had to be equipped with the sensor of a large number which detect electrocardio grade and a pulse wave like drawing 25 , and the technical problem on use occurred. In order to detect electrocardio grade with a precision sufficient about especially an electrocardio grade electrode, usually, the conductive paste had to be attached to the human body and it had to equip with the electrode pan for electrocardio grade measurement, and the operation in the case of blood pressure measurement became complicated, and the technical problem were user-unfriendly occurred.
[0006] further -- as Parameter TP -- the ratio of the 1st wave height x of the right direction of the secondary differential wave of a pulse wave, and the 1st wave height y of the negative direction, although blood pressure is calculated using the time difference Tb of y/x or the 1st peak of the right direction of a pulse wave, and the 2nd peak of the right direction For example, when it became high blood pressure and arteriosclerosis, the pulse wave configuration changed, for example, the technical problem that could not calculate Tb correctly and blood pressure did not calculate correctly since the peak of the right direction may appear only in one place occurred.
[0007]
[Means for Solving the Problem] In order that this invention may solve the above-mentioned technical problem, the pulse wave which a pulse wave detection means produces by the blood circulation of a human body is detected, and a

blood-pressure operation means calculates blood pressure based on the characteristic quantity which the characteristic quantity operation means calculated the characteristic quantity relevant to blood pressure, and calculated based on the detected pulse wave signal.
[0008] In order to calculate blood pressure based on the detected pulse wave signal according to the above-mentioned invention, while the complicatedness of the operation of only a pulse wave sensor in the case of blood pressure measurement of the sensor with which a human body is equipped is lost and its user-friendliness improves, in order to calculate the characteristic quantity relevant to blood pressure and to measure blood pressure, even if a pulse wave configuration changes, blood pressure can be measured with a sufficient precision.
[0009]
[Embodiments of the Invention] The blood-pressure-measurement equipment concerning the claim 1 of this invention has a pulse wave detection means to detect the pulse wave produced by the blood circulation of a human body, a characteristic quantity operation means to calculate the characteristic quantity relevant to blood pressure based on the pulse wave signal outputted from the aforementioned pulse wave detection means, and a blood-pressure operation means to calculate blood pressure based on the characteristic quantity signal outputted from the aforementioned characteristic quantity operation means.
[0010] And in order to calculate the characteristic quantity relevant to blood pressure and to calculate blood pressure based on the calculated characteristic quantity from the detected pulse wave signal, While the complicatedness of the operation of only a pulse wave sensor in the case of blood pressure measurement of the sensor with which a human body is equipped is lost, and prolonged run measurement also becomes possible and being able to improve user-friendliness A pulse wave detection means calculates a pulse wave interval, and the blood-pressure-measurement equipment applied to the claim 2 of this invention which can measure blood pressure with a sufficient precision even if a pulse wave configuration changes, in order to calculate the characteristic quantity relevant to blood pressure and to measure blood pressure has the amendment pulse wave amendment section for a pulse wave signal at the aforementioned intervals [a pulse wave].
[0011] And for an amendment reason, the pulse wave amendment section can measure blood pressure with a sufficient precision for a pulse wave signal irrespective of the size of a pulse at intervals of a pulse wave.
[0012] The blood-pressure-measurement equipment concerning the claim 3 of this invention has each wave height of the pulse wave signal with which a characteristic quantity operation means is outputted from a pulse wave detection means, the ratio of each aforementioned wave height, the time from a pulse wave standup point to each aforementioned wave, the time interval between each aforementioned wave, the integration value of a pulse wave, and the pulse wave characteristic quantity operation part that calculates at least one of the pulse rates as pulse wave characteristic quantity.
[0013] And in order that pulse wave characteristic quantity operation part may calculate at least one of each wave height of a pulse wave signal, the ratio of each aforementioned wave height, the time from a pulse wave standup point to each aforementioned wave, the time interval between each aforementioned wave, the integration value of a pulse wave, and the pulse rates as pulse wave characteristic quantity and a blood-pressure operation means may calculate blood pressure based on pulse wave characteristic quantity, even if it becomes high blood pressure and arteriosclerosis and a pulse wave configuration changes, blood pressure can be measured with a sufficient precision.
[0014] The speed pulse wave operation part to which the blood-pressure-measurement equipment concerning the claim 4 of this invention calculates the speed pulse wave which is the primary differential of a pulse wave based on the pulse wave signal with which a characteristic quantity operation means is outputted from a pulse wave detection means, Each wave height of the speed pulse wave signal outputted from the aforementioned speed pulse wave operation part, the ratio of each aforementioned wave height, It has the speed pulse wave characteristic quantity operation part which calculates at least one of the time from the speed pulse wave standup point describing above to each aforementioned wave, the time interval between each aforementioned wave, and the zero cross interval [of the aforementioned speed pulse wave] **s as speed pulse wave characteristic quantity.
[0015] The speed pulse wave whose speed pulse wave operation part is the primary differential of a pulse wave is calculated. speed pulse wave characteristic quantity operation part And each wave height of a speed pulse wave signal, The ratio of each aforementioned wave height, the time from the speed pulse wave standup point describing above to each aforementioned wave, the time interval between each aforementioned wave, In order that at least one of the zero cross intervals of the aforementioned speed pulse wave may be calculated as speed pulse wave characteristic quantity and a blood-pressure operation means may calculate blood pressure based on speed pulse wave characteristic quantity, even if it becomes high blood pressure and arteriosclerosis and a pulse wave configuration changes, blood pressure can be measured with a sufficient precision.
[0016] The blood-pressure-measurement equipment concerning the claim 5 of this invention has the acceleration pulse-

wave characteristic-quantity operation part which calculates at least one of each wave height of the acceleration pulse-wave signal outputted from the acceleration pulse-wave operation part which calculates the acceleration pulse wave which is the secondary differential of a pulse wave, and the aforementioned acceleration pulse-wave operation part, the ratio of each aforementioned wave height, and the time intervals between each aforementioned wave as acceleration pulse-wave characteristic quantity based on the pulse-wave signal with which a characteristic-quantity operation means is outputted from a pulse-wave detection means.

[0017] And based on the pulse wave signal with which acceleration pulse wave operation part is outputted from a pulse wave detection means, the acceleration pulse wave which is the secondary differential of a pulse wave is calculated. In order that acceleration pulse wave characteristic quantity operation part may calculate at least one of each wave height of an acceleration pulse wave signal, the ratio of each aforementioned wave height, and the time intervals between each aforementioned wave as acceleration pulse wave characteristic quantity and a blood-pressure operation means may calculate blood pressure based on acceleration pulse wave characteristic quantity, Even if it becomes high blood pressure and arteriosclerosis and a pulse wave configuration changes, blood pressure can be measured with a sufficient precision.

[0018] The blood-pressure-measurement equipment concerning the claim 6 of this invention has two or more pulse wave detecting elements to which a pulse wave detection means detects the pulse wave of the part to which a human body is different from each other, and a characteristic quantity operation means has the pulse wave propagation time and the pulse wave propagation characteristic quantity operation part to which at least one of the pulse wave velocity is calculated as pulse wave propagation characteristic quantity based on the pulse wave signal from the aforementioned pulse wave detecting element.

[0019] A pulse wave detecting element detects the pulse wave of the part to which a human body is different from each other, and pulse wave propagation characteristic quantity operation part is based on a pulse wave signal. And the pulse wave propagation time, In order that at least one of the pulse wave velocity may be calculated as pulse wave propagation characteristic quantity and a blood-pressure operation means may calculate blood pressure based on pulse wave propagation characteristic quantity, While there is no complicatedness of wearing like an electrocardio grade electrode, pulse wave propagation characteristic quantity can be calculated and user-friendliness improves, even if it becomes high blood pressure and arteriosclerosis and a pulse wave configuration changes, blood pressure can be measured with a sufficient precision.

[0020] A characteristic quantity operation means makes at least one of the height of a human body, weight, sex, and the age body characteristic quantity, and the blood-pressure-measurement equipment concerning the claim 7 of this invention has the body characteristic quantity input section which can be inputted.

[0021] And since a blood-pressure operation means calculates blood pressure based on the body characteristic quantity inputted into the body characteristic quantity input section, when practicality can be raised, blood pressure can be measured with a sufficient precision.

[0022] As for the blood-pressure-measurement equipment concerning the claim 8 of this invention, a blood-pressure operation means calculates blood pressure based on at least one of pulse wave characteristic quantity, speed pulse wave characteristic quantity, acceleration pulse wave characteristic quantity, pulse wave propagation characteristic quantity, and the body characteristic quantity.

[0023] And in order that a blood-pressure operation means may calculate blood pressure based on at least one of pulse wave characteristic quantity, speed pulse wave characteristic quantity, acceleration pulse wave characteristic quantity, pulse wave propagation characteristic quantity, and the body characteristic quantity, even if it becomes high blood pressure and arteriosclerosis and a pulse wave configuration changes, blood pressure can be measured with a sufficient precision.

[0024] The blood-pressure-measurement equipment concerning the claim 9 of this invention has the reference-value input section with a blood-pressure operation means able to input the reference value of blood pressure, and can amend the relation between at least one of pulse wave characteristic quantity, speed pulse wave characteristic quantity, acceleration pulse wave characteristic quantity, pulse wave propagation characteristic quantity, and the body characteristic quantity, and the blood pressure to calculate.

[0025] And when it can respond even if there is change of a user's blood circulation moving state by aging, body change, movement, posture change, etc. or a user changes and practicality can be raised since a relation with the blood pressure calculated with the inputted reference value with at least one of pulse wave characteristic quantity, speed pulse wave characteristic quantity, acceleration pulse wave characteristic quantity, pulse wave propagation characteristic quantity, and the body characteristic quantity can be amended for example, blood pressure can be measured with a sufficient precision.

[0026] A blood-pressure value operation means makes the reference value of blood pressure a teacher signal, and the blood-pressure-measurement equipment concerning the claim 10 of this invention learns the relation between at least one of pulse wave characteristic quantity, speed pulse wave characteristic quantity, acceleration pulse wave characteristic quantity, pulse wave propagation characteristic quantity, and the body characteristic quantity, and the blood pressure to calculate.
[0027] And the relation of the characteristic quantity information and the reference-value signal of the blood pressure from the reference-value input section which are acquired from the characteristic quantity signal from a characteristic quantity operation means is learned gradually on the spot, and since it comes to output the blood pressure corresponding to the characteristic quantity information from a characteristic quantity operation means even when he finally has no amendment by the input of a reference value, the precision of blood pressure measurement improves.
[0028] A pulse wave detection means can equip at least one part of the digiti-manus point, an earlobe, the digiti-pedis point, an overarm, a wrist, regions of neck, and a thorax with the blood-pressure-measurement equipment concerning the claim 11 of this invention, and the pulse wave of the aforementioned part is detected.
[0029] And since any part can detect a pulse wave easily by the pulse wave detection means, user-friendliness can be improved.
[0030] The blood-pressure-measurement equipment concerning the claim 12 of this invention has the 2nd pulse wave detecting element which a pulse wave detection means adjoins the 1st pulse wave detecting element which detects a pulse wave, and the 1st pulse wave detecting element, is installed from the digiti-manus point, and detects a pulse wave from parts other than the aforementioned fingertip.
[0031] And since the 1st pulse wave detecting element and the 2nd pulse wave detecting element adjoin, a miniaturization can be attained and it is convenient to carry.
[0032] The blood-pressure-measurement equipment concerning the claim 13 of this invention has the light-emitting part and light sensing portion for the 1st pulse wave detecting element and the 2nd pulse wave detecting element detecting a pulse wave by the photoelectrical pulse wave method, respectively, and both light-emitting parts are shared.
[0033] And since both light-emitting parts are shared, they can perform curtailment of parts and its practicality is high. The blood-pressure-measurement equipment concerning the claim 14 of this invention consists of a pressure sensor to which the 2nd pulse wave detecting element detects pulse pressure.
[0034] And since a pressure pulse wave is detected from regions of neck or a thorax and a pulse wave can be detected in the position near the heart, the pulse wave propagation time and the operation precision of pulse wave velocity can be improved.
[0035] The blood-pressure-measurement equipment concerning the claim 15 of this invention consists of a microphone with which the 2nd pulse wave detecting element detects a heart sound.
[0036] And since the vibration and the heart sound by the beat of the heart are detected, the pulse wave propagation time and the operation precision of pulse wave velocity can be improved.
[0037] The blood-pressure-measurement equipment concerning the claim 16 of this invention has the storage section which memorizes the blood pressure which the blood-pressure value operation means calculated.
[0038] And since it is reproducible with a blood-pressure operation means at any time, the trend of the decision value from the past etc. understands the memorized value, and it is user-friendly.
[0039] The blood-pressure-measurement equipment concerning the claim 17 of this invention has the display which displays the blood pressure which the blood-pressure value operation means calculated.
[0040] And the display of real time and the memorized past data can be displayed at any time, and it is user-friendly.
[0041] The blood-pressure-measurement equipment concerning the claim 18 of this invention has the alarm generating section which generates an alarm, when it deviates from the normal range to which the blood pressure which the blood-pressure value operation means calculated was set beforehand.
[0042] And since the alarm generating section generates an alarm when the calculated blood pressure deviates from a normal range, the abnormalities of the body under sleeping and work can be checked and it is useful to the health care.
[0043] The blood-pressure-measurement equipment concerning the claim 19 of this invention has a terminal area for communication for a blood-pressure value operation means performing communication with an external medium.
[0044] And since communication with an external medium is performed through the terminal area for communication, renewal of the concentration health care in an external medium or required information can be performed, and user-friendliness can be improved.
[0045] Hereafter, the example of this invention is explained using a drawing.
(Example 1) Drawing 1 is the block diagram of the blood-pressure-measurement equipment of the example 1 of this invention, and drawing 2 is the external view of this equipment. this example is a thing in the case of measuring blood

pressure in the finger-tip section. In drawing 1 , 8 is a pulse wave detection means to detect the pulse wave of the finger-tip section produced by the blood circulation of a human body, and it has the amendment pulse wave amendment section 10 for the pulse wave signal at intervals of the pulse wave while it calculates a pulse wave interval from the pulse wave signal outputted from photoelectricity type the pulse wave detecting element 9 and the pulse wave detecting element 9. 11 is a characteristic quantity operation means to calculate the characteristic quantity relevant to blood pressure based on the pulse wave signal outputted from the pulse wave detection means 8. Pulse wave characteristic quantity from the pulse wave signal itself The acceleration pulse wave operation part 15 which calculates the acceleration pulse wave which is the secondary differential of the speed pulse wave characteristic quantity operation part 14 which calculates speed pulse wave characteristic quantity, and a pulse wave signal from the pulse wave characteristic quantity operation part 12 to calculate, the speed pulse wave operation part 13 which calculates the speed pulse wave which is the primary differential of a pulse wave signal, and a speed pulse wave, It has the acceleration pulse wave characteristic quantity operation part 16 which calculates acceleration pulse wave characteristic quantity from an acceleration pulse wave, and the body characteristic quantity input section 17 which can input body characteristic quantity. 18 is a blood-pressure operation means to calculate blood pressure based on the characteristic quantity signal outputted from the characteristic quantity operation means 11. Pulse wave characteristic quantity, speed pulse wave characteristic quantity, acceleration pulse wave characteristic quantity, pulse wave propagation characteristic quantity, It is based on at least one of the body characteristic quantity. blood pressure The reference value of the blood-pressure operation part 19 to calculate and blood pressure When it deviates from the normal range to which the reference-value input section 20 which can be inputted, the storage section 21 which memorizes the calculated blood pressure, the display 22 which displays the calculated blood pressure, and the calculated blood pressure were set beforehand, it has the alarm generating section 23 which generates an alarm.

[0046] In drawing 2 , 24 is the main part of the blood-pressure-measurement equipment of this example, and the main part 24 consists of a pulse wave detection means 8 and a signal-processing unit 25. The pulse wave detection means 8 and the signal-processing unit 25 are connected by incurvation and the elastic connection 26 so that it can respond to the size of the finger when equipping a finger with a main part, incurvation of a knuckle, etc. 27 is the insertion section for inserting a fingertip, in case a digital pulse wave is measured, it has the flexible section 28 which can be expanded and contracted according to the size of a finger, and it is designed so that even the 1st joint of a finger can insert enough. The insertion section 27 is equipped with the 1st light-emitting part 29 and 1st light sensing portion 30 as a pulse wave detecting element 9. Although the 1st light-emitting part 29 and 1st light sensing portion 30 are using what is generally used in case they measure a photoelectrical plethysmogram, light emitting diode and a photo transistor are used, or they use the lamp which has preferably the wavelength of 5000-8000A which is the extinction band of hemoglobin in the 1st light-emitting part 29, and use the photoelectric-tube element of selenium vulcanization-ized cadmium for the 1st light sensing portion 30. The insertion section 27 is good also as composition which can fold using the flexible section 28. In addition, although it is the composition that the amount of the light which penetrates the fingertip which was made to carry out the right pair of the 1st light-emitting part 29 and 1st light sensing portion 30, and inserted them in the above detects a pulse wave, it is good also as composition which detects the reflected light from the fingertip which the 1st light-emitting part 29 and 1st light sensing portion 30 were made to adjoin, and was inserted, and detects a pulse wave. The signal-processing unit 25 has the characteristic quantity operation means 11 and the blood-pressure operation means 18, and the body characteristic quantity input section 17, the reference-value input section 20, a display 22, and the alarm generating section 23 are installed in the front face. 31 is a terminal area for communication for performing communication with a main part 24 and an external medium. Although the drive of a main part 24 performs the cell built in the interior of a main part as a power supply, you may supply a power supply from the exterior through the terminal of the terminal area 31 for communication.

[0047] Next, operation and an operation are explained. A fingertip is inserted in the insertion section 27, the digiti-manus point is equipped with a main part 24 like drawing 3 , and measurement of blood pressure is started. Drawing 4 is a flow chart in the case of blood pressure measurement. A pulse wave is first detected by ST1. Here, the pulse wave detecting element 9 (the 1st light-emitting part 29, the 1st light sensing portion 30) detects a digital pulse wave. The general configuration of the detected pulse wave is shown in drawing 5 (a) and drawing 6 (b). Drawing 5 (a) is a pattern of pulse wave which is looked at by the youth with mainly normal blood pressure, and is called normal catacrotic wave. Drawing 6 (a) is a pattern of pulse wave which is looked at by a high-blood-pressure person and elderly people, and is called anacrotic wave. Since agitation of a baseline may arise by the movement of the body etc., the pulse wave amendment section 10 extracts two or more patterns of pulse wave in every beat from a pulse wave signal, and doubles and averages a baseline, and the pulse wave signal which the pulse wave detecting element 9 detected asks for an average pattern of pulse wave. And based on this wave, the pulse wave amendment section 10 asks for the pulse wave

interval Pi (ST2), and amends the time-axis of the original pattern of pulse wave if needed. (ST3) This is because there is amendment need in a pulse rate among the characteristic quantity of a pattern of pulse wave which individual differences are and mention later about individual differences about a time element. The formula of Bazzet (Bazzet, H, C., 1920) shown if attached to an amendment formula (several 1) is used.

[0048]

[Equation 1]

$$\text{補正値} = \text{測定値} / \sqrt{\text{Pi}}$$

[0049] Next, the characteristic quantity operation means 11 calculates characteristic quantity based on the pulse wave signal from the pulse wave amendment section 10 by ST4. How to calculate characteristic quantity using drawing 5 - drawing 7 is explained. In drawing 5 and drawing 6 , (b) is calculated by the speed pulse wave operation part 13 by the wave of the speed pulse wave which differentiated the primary pulse wave. Moreover, (c) calculates a pulse wave by the acceleration pulse wave operation part 15 by the wave of the acceleration pulse wave differentiated the 2nd order. As for S, a pulse wave starts in drawing 5 (a) and drawing 6 (a), a notch and D are called relaxation crest and A is called [a point and P / ******** and T] before **** for the tidal wave and C.

[0050] In the pulse wave characteristic quantity operation part 12, P is called for as the wave-like maximum point. About T, C, and D, by drawing 5 (a), since it has appeared as a clear peak, it can ask as a zero crossing point of a speed pulse wave. When A, C, and D do not appear as a clear peak like drawing 6 (a), it carries out like drawing 7 and asks for A, C, and D. First, about A, from the zero crossing point of an acceleration pulse wave, perpendiculars l1 and l2 are drawn and tangents l3 and l4 are drawn in the intersections p1 and p2 of l1, l2, and a sphygmogram. In case l2 is subtracted here, when there is no zero crossing point near the point pc of an acceleration pulse wave like drawing 7 (c), l2 is subtracted from the pgamma of the maximum points. And a perpendicular l5 is drawn from the intersection p3 of l3 and l4 to a baseline, and the intersection of l5 and a sphygmogram is set to A. About C, from the zero crossing point of an acceleration pulse wave, perpendiculars l6 and l7 are drawn and tangents l8 and l9 are drawn in the intersections p4 and p5 of l6, l7, and a sphygmogram. And a perpendicular l10 is drawn from the intersection p6 of l8 and l9 to a baseline, and the intersection of l10 and a sphygmogram is set to C. About D, from the zero crossing point of an acceleration pulse wave, a perpendicular l11 is drawn and a tangent l12 is drawn in the intersection p7 of l11 and a sphygmogram. And a perpendicular l13 is drawn from the intersection p8 of l9 and l12 to a baseline, and the intersection of l13 and a sphygmogram is set to D. Thus, although it asks for P, T, C, D, and A, you may ask using technique, such as wave-like pattern recognition. In the pulse wave characteristic quantity operation part 12, after asking for P, T, C, D, and A as mentioned above, at least one of each wave height of P, T, C, D, and A, the ratio of each aforementioned wave height, the time from a pulse wave standup point to each aforementioned wave, the time interval between each aforementioned wave, the integration value of a pulse wave, and the pulse rates is calculated. As shown, for example in drawing 5 (a) and drawing 6 (a) among these, it considers as the wave height and, in the case of a normal catacrotic wave, in the case of alpha, beta, gamma, delta, and an anacrotic wave, the amplitude of A, P, C, and D is asked for alpha, beta, gamma, delta, and the maximum wave height for the amplitude of P, T, C, and D as H (in the case of a normal catacrotic wave, in the case of alpha and an anacrotic wave, it is beta), respectively. It asks for alpha/beta as a ratio of the wave height, and asks for EI and gamma/H as DI. Tu is calculated as time from a pulse wave standup point to each wave, and S-P and S-C are calculated as Te, respectively. As a time interval between each wave, the integration value to S-P is calculated as Tr and an integration value of a pulse wave, and Isp, and a pulse rate 60/Pi is calculated for P-C as HR. In addition, a pulse wave starts, and Point S is good in asking as intersection S' of a tangent l3 and a baseline also as S" (baseline side) of the branch points of a sphygmogram and a tangent l3, as shown in drawing 7 (a). Moreover, you may ask also about A and C as the branch point (******** P side) of a sphygmogram and a tangent l3, and the branch point (baseline side) with a tangent l8, respectively.

[0051] In the speed pulse wave characteristic quantity operation part 12, at least one of each wave height of the speed pulse wave signal outputted from the speed pulse wave operation part 13, the ratio of each aforementioned wave height, the time from the speed pulse wave standup point describing above to each aforementioned wave, the time interval between each aforementioned wave, and the zero cross intervals of the aforementioned speed pulse wave is calculated as speed pulse wave characteristic quantity. As shown, for example in drawing 5 (b) and drawing 6 (b) among these, it asks for the maximum wave height v of a speed pulse wave as the wave height, and it asks for the period Tu whose speed pulse wave is positive as a time interval between each wave.

[0052] In the acceleration pulse wave characteristic quantity operation part 16, at least one of each wave height of the acceleration pulse wave signal outputted from the acceleration pulse wave operation part 15, the ratio of each aforementioned wave height, and the time intervals between each aforementioned wave is calculated as acceleration

pulse wave characteristic quantity. Among these, as shown, for example in drawing 5 (c) and drawing 6 (c), it asks for the amplitude a, b, c, d, and e of the wave-like maximum point and the minimum point as the wave height. Here, if each maximum point and the minimum point are above a baseline, if a, b, c, d, and e are below a baseline, they will make a positive value a negative value. b/a, c/a, d/a, and e/a are calculated as a ratio of each wave height, and it is referred to as Rb, Rc, Rd, and Re, respectively.

[0053] It is possible to input at least one of a user's height, weight, sex, and the age as body characteristic quantity if needed from the body characteristic quantity input section 17.

[0054] Although the characteristic quantity operation means 11 calculates the characteristic quantity relevant to blood pressure as mentioned above for example, asking for delta/gamma by the pulse wave, or finding the time to an amplitude c, since a wave starts by the acceleration pulse wave etc. Other indexes which were not shown above may be calculated, or a differential-of-higher-order wave may be calculated further, and at least one of the ratio of each wave height and each aforementioned wave height and each of the aforementioned wave interval may be calculated as characteristic quantity.

[0055] In ST5, the blood-pressure operation means 18 calculates blood pressure from the judgment line set up beforehand. This judgment line and an operation procedure are explained using drawing 8 - drawing 13 . Drawing 8 shows the judgment lines L1 and L2 in the case of calculating blood pressure BP, using EI and DI as characteristic quantity. L1 is an object for maximal pressure, and L2 is an object for the lowest blood pressure here. Blood pressure will tend to become high if EI of EI is small in relation to the elasticity of an arterial canal wall. Blood pressure will tend to become high if DI of DI is large in relation to the aperture of an arterial canal, i.e., the tonus degree of an arterial canal. In the blood-pressure operation part 19, highest blood pressure BP1 and the lowest blood pressure BP2 calculate from EI0 and DI based on drawing 8 . Drawing 9 shows the judgment lines L3 and L4 in the case of calculating blood pressure BP, using Tu and Te as characteristic quantity. L3 is an object for maximal pressure, and L4 is an object for the lowest blood pressure here. Blood pressure will tend to become high if Tu of Tu is large in relation to time until the cardiac contractile force after opening reaches [an aortic valve] maximum. Moreover, blood pressure will tend to become high if Te of Te is large in relation to the time which the aortic valve has opened wide. In the blood-pressure operation part 19, highest blood pressure BP3 and the lowest blood pressure BP4 calculate from Tu0 and Te based on drawing 9 . Drawing 10 shows the judgment lines L5 and L6 in the case of calculating blood pressure BP, using Tu0 and v as characteristic quantity. L5 is an object for maximal pressure, and L6 is an object for the lowest blood pressure here. Blood pressure will tend to become high if Tu of pulse wave velocity is large since the time is also short, when, as for Tu, blood is smoothly sent into the tip in addition to the above-mentioned as mentioned above in relation to the size of vessel resistance positive. Blood pressure will tend to become high if v of v is small in relation to the speed to which a pulse wave starts. In the blood-pressure operation part 19, highest blood pressure BP5 and the lowest blood pressure BP6 calculate from Tu0 and v based on drawing 10 . Drawing 11 shows the judgment lines L7 and L8 in the case of calculating blood pressure BP, using Rb and Rd as characteristic quantity. L7 is an object for maximal pressure, and L8 is an object for the lowest blood pressure here. Blood pressure will tend to become high if the negative value of Rb of Rb is small in relation to the output of the heart. Blood pressure will tend to become high if the negative value of Rd of Rd is large in relation to the size of the burden of the heart. In the blood-pressure operation part 19, highest blood pressure BP7 and the lowest blood pressure BP8 calculate from Rb and Rd based on drawing 11 . Drawing 12 shows the judgment lines L9 and L10 in the case of calculating blood pressure BP, using EI0 and age as characteristic quantity. L9 is an object for maximal pressure, and L10 is an object for the lowest blood pressure here. EI is as above-mentioned, and blood pressure tends to become high as age becomes high. In the blood-pressure operation part 19, highest blood pressure BP9 and the lowest blood pressure BP10 calculate from EI0 and age based on drawing 12 . Drawing 13 shows the judgment lines L11 and L12 in the case of calculating blood pressure BP, using Tu0 and Rd as characteristic quantity. L11 is an object for maximal pressure, and L12 is an object for the lowest blood pressure here. It is as [Rd / Tu0 and] above-mentioned. In the blood-pressure operation part 19, highest blood pressure BP11 and the lowest blood pressure BP12 calculate from Tu0 and Rd based on drawing 13 .

[0056] At ST6, if the reference value of blood pressure is inputted into the reference-value input section 20, amendment of a judgment line will be performed by ST7. Drawing 14 is explained to an example for the concrete procedure of amendment. Drawing 14 is the thing of an amendment sake about the judgment lines L1 and L2 which calculate blood pressure BP based on EI and DI which were shown in drawing 8 . In addition, DI shall be fixed in order to simplify explanation. During EI0' measurement, blood-pressure BP1' and BP2' are simultaneously measured with the sphygmomanometer of a cuff formula, and it inputs from the reference-value input section 20 by making these values into a reference value. In ST7, the blood-pressure operation part 19 amends the judgment lines L1 and L2 based on the inputted reference value. That is, if points p8 and p9 can be found by reference-value EI0', BP1', and BP2' from drawing

14 , the parallel displacement of the judgment lines L1 and L2 will be carried out so that it may pass along p8 and p9, and the newly made judgment line is made into L1' and L2'. Henceforth, the blood-pressure operation part 20 calculates BP1 and BP2 from EI0 using judgment line L1' and L2'. In addition, when there is no input of a reference value at ST6, the blood-pressure operation part 20 does not amend a judgment line.

[0057] The blood pressure called for by doing in this way in ST8 is memorized in the storage section 21, and blood pressure is displayed on a display 22 in ST9. It can reproduce at any time and the value memorized by the storage section 21 can be displayed on a display 22. When the calculated blood pressure deviates from the normal range set up beforehand, the alarm generating section 23 generates an alarm in ST10 and ST11. You may make it report generating of an alarm to the 3rd person who is in the place which is distant from a user by the cable or radio. The blood-pressure value calculated and memorized can communicate through the terminal area 31 for communication to external media, such as an external monitor, centralized-control equipment, a personal computer, and a cellular phone. Moreover, it is also possible to perform the input of characteristic quantity or a reference value, a judgment line, renewal of the normal range for alarm generating, etc. through the terminal area 31 for communication from an external medium.

[0058] The above-mentioned judgment line can process the result chosen by for example, the subject experiment etc. by statistical technique, and can search for it. Moreover, the characteristic quantity at the time of asking for a judgment line is not limited to the range of the above-mentioned example, and may ask for a judgment line from at least one, such as other characteristic quantity calculated with the characteristic quantity operation means 11, for example, alpha-delta, HR and Pi, delta/gamma, Isp, a-e, Rc and Re, acceleration pulse wave each wave interval, characteristic quantity chosen more than from the 4th differential wave of a pulse wave, height, weight, and sex. Moreover, although blood pressure was calculated from at least two characteristic quantity in the above-mentioned example, you may calculate blood pressure from three or more characteristic quantity.

[0059] Moreover, although it was the composition of detecting the pulse wave of a fingertip, in this example as shown in drawing 2 and drawing 3 , it is good also as the composition which detects a photoelectrical pulse wave from an earlobe or the digiti-pedis point, and composition which detects the pressure pulse wave of main arteries from an overarm, a wrist, regions of neck, and a thorax. In this case, as composition which detects a photoelectrical pulse wave, the 1st light-emitting part 29 as shown in the above-mentioned example, and the 1st light sensing portion 30 are used according to detecting-element grade. Moreover, it is good to use a pressure sensor and an acceleration sensor, for example, and to use sensors, such as a desirable flexible film-like macromolecule piezo-electricity sensor and a strain gage, as composition which detects a pressure pulse wave, according to detecting-element grade.

[0060] In order according to the example 1 of this invention to calculate the characteristic quantity relevant to blood pressure and to calculate blood pressure based on the calculated characteristic quantity from the detected pulse wave signal, While the complicatedness of the operation of only a pulse wave sensor in the case of blood pressure measurement of the sensor with which a human body is equipped is lost, and prolonged run measurement also becomes possible and being able to improve user-friendliness In order to calculate the characteristic quantity relevant to blood pressure and to measure blood pressure, even if a pulse wave configuration changes, blood pressure can be measured with a sufficient precision.

[0061] Moreover, for an amendment reason, the pulse wave amendment section can calculate blood pressure with a sufficient precision for a pulse wave signal irrespective of the size of a pulse at intervals of a pulse wave.

[0062] Moreover, in order that wave characteristic quantity operation part may calculate at least one of each wave height of a pulse wave signal, the ratio of each aforementioned wave height, the time from a pulse wave standup point to each aforementioned wave, the time interval between each aforementioned wave, the integration value of a pulse wave, and the pulse rates as pulse wave characteristic quantity and a blood-pressure operation means may calculate blood pressure based on pulse wave characteristic quantity, even if it becomes high blood pressure and arteriosclerosis and a pulse wave configuration changes, blood pressure can be measured with a sufficient precision.

[0063] The speed pulse wave whose speed pulse wave operation part is the primary differential of a pulse wave is calculated. speed pulse wave characteristic quantity operation part Moreover, each wave height of a speed pulse wave signal, The ratio of each aforementioned wave height, the time from the speed pulse wave standup point describing above to each aforementioned wave, the time interval between each aforementioned wave, In order that at least one of the zero cross intervals of the aforementioned speed pulse wave may be calculated as speed pulse wave characteristic quantity and a blood-pressure operation means may calculate blood pressure based on speed pulse wave characteristic quantity, even if it becomes high blood pressure and arteriosclerosis and a pulse wave configuration changes, blood pressure can be measured with a sufficient precision.

[0064] Moreover, based on the pulse wave signal with which acceleration pulse wave operation part is outputted from a pulse wave detection means, the acceleration pulse wave which is the secondary differential of a pulse wave is

calculated. In order that acceleration pulse wave characteristic quantity operation part may calculate at least one of each wave height of an acceleration pulse wave signal, the ratio of each aforementioned wave height, and the time intervals between each aforementioned wave as acceleration pulse wave characteristic quantity and a blood-pressure operation means may calculate blood pressure based on acceleration pulse wave characteristic quantity, Even if it becomes high blood pressure and arteriosclerosis and a pulse wave configuration changes, blood pressure can be measured with a sufficient precision.

[0065] Moreover, since a blood-pressure operation means calculates blood pressure based on the body characteristic quantity inputted into the body characteristic quantity input section, when practicality can be raised, blood pressure can be measured with a sufficient precision.

[0066] Moreover, when it can respond even if there is change of a user's blood circulation moving state by aging, body change, movement, posture change, etc. or a user changes and practicality can be raised since a relation with the blood pressure calculated with the inputted reference value with at least one of pulse wave characteristic quantity, speed pulse wave characteristic quantity, acceleration pulse wave characteristic quantity, and the body characteristic quantity can be amended for example, blood pressure can be measured with a sufficient precision.

[0067] Moreover, it has the storage section which memorizes ****** which the blood-pressure operation means calculated, and since it is reproducible with a blood-pressure operation means at any time, the trend of the decision value from the past etc. understands the memorized value, and it is user-friendly.

[0068] Moreover, since it has the display which displays the blood pressure which the blood-pressure value operation means calculated, the display of real time and the memorized past data can be displayed at any time, and it is user-friendly.

[0069] Moreover, since the alarm generating section generates an alarm when the calculated blood pressure deviates from a normal range, the abnormalities of the body under sleeping and work can be checked and it is useful to the health care.

[0070] Furthermore, since it has a terminal area for communication for a blood-pressure value operation means performing communication with an external medium and communication with an external medium is performed, renewal of the concentration health care in an external medium or required information can be performed, and user-friendliness can be improved.

[0071] (Example 2) The block diagram in which drawing 15 shows the blood-pressure-measurement equipment of the example 2 of this invention, drawing 16 , and drawing 17 are the external views of this equipment.

[0072] In this example 2, as for a different point from an example 1, the pulse wave detection means 8 has two or more pulse wave detecting elements 9a-9n which detect the pulse wave of the part to which a human body is different from each other. The characteristic quantity operation means 11 is based on a pulse wave signal from the pulse wave detecting elements 9a-9n. The pulse wave propagation time, It has the pulse wave propagation characteristic quantity operation part 32 which calculates at least one of the pulse wave velocity as pulse wave propagation characteristic quantity. While the blood-pressure operation means 18 calculates blood pressure based on at least one of pulse wave characteristic quantity, speed pulse wave characteristic quantity, acceleration pulse wave characteristic quantity, pulse wave propagation characteristic quantity, and the body characteristic quantity It is the point of making the reference value of blood pressure into a teacher signal, and learning the relation between at least one of pulse wave characteristic quantity, speed pulse wave characteristic quantity, acceleration pulse wave characteristic quantity, pulse wave propagation characteristic quantity, and the body characteristic quantity, and the blood pressure to calculate. Drawing 16 and drawing 17 are the external views of the main part 24 in the case of detecting two pulse waves, a fingertip and other parts. Drawing 16 is drawing which looked at the insertion section 27 of an example 1 as came to the bottom, and the opposite side is equipped with the 2nd light-emitting part 33 and 2nd light sensing portion 34 in this example with the side which inserts the fingertip of the insertion section 27. The 2nd light-emitting part 33 and 2nd light sensing portion 34 are constituted so that the pulse wave in parts other than a fingertip may be detected, for example, they have the same structure as the 1st light-emitting part 29 and the 1st light sensing portion 30. Here, pulse wave detecting-element 9a', and the 1st light-emitting part 33 and 2nd light sensing portion 34 become [the 1st light-emitting part 29 and the 1st light sensing portion 30] 2nd pulse wave detecting-element 9b'. [2nd] In addition, it is good also as composition which makes the 1st light-emitting part 29 and 2nd light-emitting part 33 serve a double purpose as the same thing. Drawing 17 is the example in which the same place as having equipped with the 1st light-emitting part 29 and the 1st light sensing portion 30 by drawing 16 was equipped with the pressure sensor 35 as 2nd pulse wave detecting-element 9b'. A pressure sensor 35 detects vibration by the pressure variation (pressure pulse wave) on the front face of the skin by the pulse in parts other than a fingertip, or the beat of the heart, and consists of film-like flexible macromolecule piezo-electricity sensors and strain gages. Moreover, 2nd pulse wave detecting-element 9b' may consist of microphones which

detect a heart sound.
[0073] In addition, the thing of the same sign as an example 1 has the same structure, and explanation is omitted. Next, operation and an operation are explained. While inserting a fingertip in pulse wave detecting-element 9a' of the insertion section 27 and equipping a fingertip with a main part 24 like drawing 18 , pulse wave detecting-element 9b' is contacted to any one part of an earlobe, regions of neck, and the thorax, and measurement of blood pressure is started. When the following is contacted to an earlobe, it advances [******] explanation. Since the flow chart in the case of blood pressure measurement is the same as that of drawing 4 , here explains the detailed procedure of ST4 and ST5 using drawing 4 . If a pulse wave is detected by ST1-ST3 and a pulse wave is amended if needed, the characteristic quantity operation means 11 will calculate characteristic quantity based on the pulse wave signal from the pulse wave amendment section 10 by ST4. It is as the 1st example having described the operation of pulse wave characteristic quantity, speed pulse wave characteristic quantity, acceleration pulse wave characteristic quantity, and body characteristic quantity. Here, the procedure of calculating the pulse wave propagation time and pulse wave velocity as pulse wave propagation characteristic quantity by the pulse wave propagation characteristic quantity operation part 32 using drawing 19 and drawing 20 is explained. Drawing 19 (a) and (b) show the pulse wave signal detected by the fingertip and the earlobe, respectively. The pulse wave from an earlobe contacts 2nd pulse wave detecting-element 9b' of drawing 16 to an earlobe, and detects it. From drawing 19 , each pulse wave starts and the pulse wave propagation time is found as time difference Tc of points S1 and S2. Moreover, if a user's height, weight, sex, age, etc. are beforehand inputted from the body characteristic quantity input section 17, based on the inputted body characteristic quantity, the blood circulation path length from the heart of an earlobe and each fingertip will calculate by the pulse wave propagation characteristic quantity operation part 32, and the characteristic quantity equivalent to pulse wave velocity will be obtained by breaking Tc by the difference of both length.
[0074] In ST5, the blood-pressure operation means 18 calculates blood pressure from the judgment line set up beforehand. Drawing 20 shows the judgment lines L13 and L14 in the case of calculating blood pressure BP, using Tu0 and Tc as characteristic quantity. L13 is an object for maximal pressure, and L14 is an object for the lowest blood pressure here. It is as having mentioned above about Tu0. Blood pressure will tend to become high if Tc of Tc is small in relation to the resistance degree of an arterial canal. In the blood-pressure operation part 19, highest blood pressure BP13 and the lowest blood pressure BP14 calculate from Tu0 and Tc based on drawing 20 .
[0075] In addition, although the photoelectrical pulse wave was detected from the fingertip and the earlobe using the main part 24 shown in drawing 16 in the above-mentioned example, by contacting 2nd pulse wave detecting-element 9b' to regions of neck or a thorax like drawing 18 using the main part 24 shown in drawing 17 , a photoelectrical pulse wave is detected from a fingertip, a pressure pulse wave may be detected from regions of neck or a thorax, and the pulse wave propagation time and pulse wave velocity may be calculated from a pressure pulse wave and the pulse wave of the digiti-manus point. Moreover, a microphone may detect a heart sound as a thing according to a pulse wave, the pulse wave propagation time and pulse wave velocity may be calculated from the pulse wave of a heart sound and a fingertip, and since both sides can detect a pressure pulse wave and a heart sound in the position near [earlobe] the heart, the pulse wave propagation time and the operation precision of pulse wave velocity improve.
[0076] Next, at ST6, if the reference value of blood pressure is inputted into the reference-value input section 20, amendment of a judgment line will be performed by ST7. The reference value of blood pressure is inputted in the same procedure as an example 1. In this case, pulse wave characteristic quantity, Although it is good as for a method of an amendment, the relation between at least one of speed pulse wave characteristic quantity, acceleration pulse wave characteristic quantity, pulse wave propagation characteristic quantity, and the body characteristic quantity, and the blood pressure to calculate Here, the reference value of blood pressure into which the blood-pressure value operation part 19 was inputted further is made into a teacher signal, and amendment of a judgment line is performed by learning the relation between at least one of pulse wave characteristic quantity, speed pulse wave characteristic quantity, acceleration pulse wave characteristic quantity, pulse wave propagation characteristic quantity, and the body characteristic quantity, and the blood pressure to calculate. The learning technique which imitated the neuron network is used as a composition means of the blood-pressure value operation part 19 which learns. I suppose now that input data is at least one of the pulse wave characteristic quantity from the characteristic quantity operation means 11, speed pulse wave characteristic quantity, acceleration pulse wave characteristic quantity, pulse wave propagation characteristic quantity, and the body characteristic quantity, and output data are the blood-pressure signals to the storage section 21 and a display 22, and think that a desirable output (namely, teacher signal) is an output signal from the reference-value input section 20. Let a reference value be the value of the blood pressure measured by the sphygmomanometer of a cuff formula. As a ********** type means, there are some which were shown in reference 1 (two persons besides a PDP model and D.E. Rumelhart, the Shun'ichi Amari supervision of translation, 1989), reference 2 (the foundation of a neuro

computer, p102, seven Nakano ****, 1990), JP,63-55106,B, etc.
[0077] The multilayer perceptron which was indicated by reference 1 and which was known best using the error reverse spreading method as learning algorithm is hereafter taken for an example, and the composition and operation of a concrete ********** type means are explained.
[0078] Drawing 21 is the conceptual diagram of the nerve element used as the composition unit of a ********** type means. It is the sigmoid function with which 401-40N are false synapse joint converters which carry out the ** type of the nervous synapse combination in drawing 21 , 40a is an adder adding the output from the false synapse joint converters 401-40N, and 40b sets to h the set-up nonlinear function, for example, a threshold, and [0079].
[Equation 2]

$$f(y, h) = 1 / (1 + \exp(-y + h))$$

[0080] It is the nonlinear converter which is alike and therefore carries out nonlinear conversion of the output of adder 40a. In addition, although it omitted since the drawing became complicated, the input line which receives the correcting signal from a correction means is connected with the false synapse joint converters 401-40N and nonlinear converter 40b. Moreover, the false synapse joint converters 401-40N serve as a joint weighting factor of a ********** type means. There is a mode of operation of two kinds, signal-processing mode and learning mode, in this nerve element.
[0081] Hereafter, operation in each mode of a nerve element is explained based on drawing 21 . First, operation in signal-processing mode is explained. A nerve element takes out one output in response to N inputs X1-Xn. The i-th input signal Xi is changed into Wi-Xi in square and shown i-th false synapse joint converter 40i. N signals W1 changed with the false synapse joint converters 401-40N, X1 - Wn-Xn go into adder 40a, and the addition result y is sent to nonlinear converter 40b, and they serve as the final output f (y, h). Below, operation of learning mode is explained. It is [0082] in response to the correcting signal which expresses the amounts delta W1-delta Wn of corrections of the conversion parameter from a correction means, and deltah in learning mode as the false synapse joint converters 401-40N and the conversion parameters W1-Wn of nonlinear converter 40b for h.
[Equation 3]

$$W_i + \Delta W_i \quad ; \quad i = 1, 2, \cdots, N$$

$$h + \Delta h$$

[0083] It corrects. Drawing 22 is the conceptual diagram of the signal transformation means which connected the above-mentioned nerve element with 4 parallel, and constituted it. The following explanation needless to say does not specify the number of the nerve element which constitutes this signal transformation means as four pieces. In drawing 22 , 511-544 are false synapse joint converters, and 501-504 are the addition nonlinear converters to which adder 40a explained by drawing 21 and nonlinear converter 40b were summarized. In drawing 22 , although it omitted since the drawing became complicated like drawing 21 , the input line which receives the correcting signal from a correction means is connected with the false synapse joint converters 511-544 and the addition nonlinear converters 501-504. The false synapse joint converters 511-544 also serve as a joint weighting factor. About operation of this signal transformation means, operation of the nerve element explained by drawing 21 stands in a row, and is made.
[0084] Drawing 23 is the block diagram having shown the composition of the signal-processing means at the time of adopting the error reverse spreading method as learning algorithm, and 61 is an above-mentioned signal transformation means. However, the nerve element which receives N inputs here is put in order by M piece parallel. 62 is a correction means to compute the amount of corrections of the signal transformation means 61 in learning mode. Hereafter, operation in the case of learning a signal-processing means based on drawing 23 is explained. The signal transformation means 61 receives N inputs Sin (X), and outputs M outputs Sout (X). The correction means 62 receives an input signal Sin (X) and an output signal Sout (X), and it stands by until there are M inputs of error-signal deltaj (X) from an error calculation means or a latter signal transformation means. Error-signal deltaj (X) is inputted and it is the amount of corrections [0085]
[Equation 4]

$$\Delta W_{ij} = \delta_j(X) \cdot S_{jout}(X) \cdot (1 - S_{jout}(X)) \cdot S_{iin}(X)$$

$$(i = 1 \sim N, \; j = 1 \sim M)$$

[0086] It calculates and a correcting signal is sent to the signal transformation means 61. The signal transformation means 61 is corrected according to the learning mode which explained the conversion parameter of an internal nerve element in the top.

[0087] Drawing 24 is the block diagram showing the composition of the multilayer perceptron which used the ********** type means, 71X, 71Y, and 71Z are signal transformation meanses which consist of K pieces, L pieces, and M nerve elements, respectively, 72X, 72Y, and 72Z are correction meanses, and 73 is an error calculation means. The operation is explained about the multilayer perceptron constituted as mentioned above, referring to drawing 24 . In signal-processing means 70X, signal transformation means 71X receives Input Siin (X) and (i=1-N), and outputs Output Sjout (X) and (j=1-K). Correction means 72X receives Signal Siin (X) and Signal Sjout (X), and it stands by until error-signal deltaj (X) and (j=1-K) are inputted. The same processing as the following is performed in the signal-processing meanses 70Y and 70Z, and the signal transformation means 71 right-hand-lay final output Shout (Z) and (h=1-M) are outputted. The final output Shout (Z) is sent also to the error calculation means 73. In the error calculation means 73, an error with the ideal output T (T1, ..., TM) is calculated by being based on being shown in the performance-index COST following of a square error (formula 5), and error-signal deltah (Z) is sent to correction means 72Z.
[0088]
[Equation 5]

$$COST=\mu \cdot \sum_{h=1}^{M} (Th-Shout\ (Z))^{2}/2$$

[0089] However, mu is a parameter which defines the study speed of a multilayer perceptron. Next, an error signal is
[0090] when a performance index is made into a square error.
[Equation 6]

$$\delta h\ (Z) = -\mu \cdot (Shout\ (Z) - Th)$$

[0091] It becomes. According to the procedure explained in the top, correction means 72Z calculates amount of corrections delta[of the conversion parameter of signal transformation means 71Z] W (Z), calculates the error signal sent to correction means 72Y based on (a formula 7), sends correcting-signal deltaW (Z) to signal transformation means 71Z, and sends error-signal delta (Y) to correction means 72Y. Signal transformation means 71Z corrects an internal parameter based on correcting-signal deltaW (Z). In addition, error-signal delta (Y) is given by (the formula 7).
[0092]
[Equation 7]

$$\delta j\ (Y) = \sum_{i=1}^{M} \delta i\ (Z) \cdot Sjout\ (Z) \cdot (1-Sjout\ (Z)) \cdot wij\ (Z)$$

[0093] Here, wij (Z) is the conversion parameter of the false synapse joint converter of signal transformation means 71Z. Hereafter, same processing is performed in the signal-processing meanses 70X and 70Y. By repeating the procedure of the more than called study and performing it, a multilayer perceptron will come to take out the output which approximates the ideal output T well, if an input is given. In addition, in the above-mentioned explanation, although three steps of multilayer perceptrons were used, this may be how many steps. Moreover, although omitted for simplification of explanation about the method of study improvement in the speed learned as an inertial term as it is about the method of correcting the conversion parameter h of the nonlinear conversion means in the signal transformation means in reference 1, this abbreviation does not restrain this invention.
[0094] Thus, when it is not easy to describe with an easy rule what operation is desirable using the information acquired from characteristic quantity signals, such as pulse wave characteristic quantity from the characteristic quantity operation means 11, speed pulse wave characteristic quantity, acceleration pulse wave characteristic quantity, pulse wave propagation characteristic quantity, and body characteristic quantity, and the output signal of the reference-value input section 20, study can express the blood-pressure operation part 19 with the ********** type means in a natural form based on the past experience.
[0095] In other words, by learning gradually the relation of the characteristic quantity information and the reference-value signal of the blood pressure from the reference-value input section 20 which are acquired from the characteristic quantity signal from the characteristic quantity operation means 11 on the spot, the blood-pressure operation part 19 comes to output the blood pressure corresponding to the characteristic quantity information from the characteristic quantity operation means 11, even when he finally has no amendment by the input of a reference value. If the blood pressure which the user newly calculated using the reference-value input section 20 is corrected when the still more nearly same user also changes the posture at the time of measurement, other users from whom a form is different use it or it measures during movement, the blood-pressure operation part 19 is also followed by study at this.

[0096] By the way, as a composition means of the blood-pressure operation part 19 which learns, you may use the competition pattern classification type vector quantization learning method suitable for the additional study instead of the error reverse spreading method etc. Moreover, not using the learning technique which imitated the neuron network, you may use technique, such as a table lookup method based on the suitable rule, and artificial intelligence, a genetic algorithm.
[0097] According to the example 2 of this invention, a pulse wave detecting element detects the pulse wave of the part to which a human body is different from each other. In order that pulse wave propagation characteristic quantity operation part may calculate at least one of the pulse wave propagation time and the pulse wave propagation velocity as pulse wave propagation characteristic quantity based on a pulse wave signal and a blood-pressure operation means may calculate blood pressure based on pulse wave propagation characteristic quantity, While there is no complicatedness of wearing like an electrocardio grade electrode, pulse wave propagation characteristic quantity can be calculated and user-friendliness improves, even if it becomes high blood pressure and arteriosclerosis and a pulse wave configuration changes, blood pressure can be measured with a sufficient precision.
[0098] Moreover, in order that a blood-pressure operation means may calculate blood pressure based on at least one of pulse wave characteristic quantity, speed pulse wave characteristic quantity, acceleration pulse wave characteristic quantity, pulse wave propagation characteristic quantity, and the body characteristic quantity, even if it becomes high blood pressure and arteriosclerosis and a pulse wave configuration changes, blood pressure can be measured with a sufficient precision.
[0099] moreover, the relation of the characteristic-quantity information and the reference-value signal of the blood pressure from the reference-value input section acquired from the characteristic-quantity signal from a characteristic-quantity operation means learns gradually on the spot, and since it comes to output the blood pressure corresponding to the characteristic-quantity information from a characteristic-quantity operation means even when he finally has no amendment by the input of a reference value, it is effective in the precision of blood pressure measurement being markedly alike, and improving rather than an example 1
[0100] Moreover, since it has the 2nd pulse wave detecting element which a pulse wave detection means adjoins the 1st pulse wave detecting element which detects a pulse wave, and the 1st pulse wave detecting element, is installed from the fingertip of a hand, and detects a pulse wave from parts other than the aforementioned fingertip, a miniaturization can be attained and it is convenient to carry.
[0101] Moreover, the 1st pulse wave detecting element and the 2nd pulse wave detecting element have the light-emitting part and light sensing portion for a photoelectrical pulse wave method detecting a pulse wave, respectively, since both light-emitting parts are shared, they can perform curtailment of parts and practicality is high [light-emitting parts].
[0102] Moreover, the 2nd pulse wave detecting element consists of a pressure sensor which detects pulse pressure, and since it detects a pressure pulse wave from the neck or a thorax and can detect a pulse wave in the position near the heart, it can improve the operation precision of the pulse wave propagation time and pulse wave propagation velocity.
[0103] Furthermore, the 2nd pulse wave detecting element is good also as a microphone which detects a heartbeat, and since it detects the vibration and the heartbeat by the beat of the heart, it can improve the operation precision of the pulse wave propagation time and pulse wave propagation velocity.
[0104] In addition, while each characteristic quantity calculated as examples 1 and 2 described relates to blood pressure, EI can also judge the right and wrong of the blood circulation moving state of human bodies other than blood pressure from each characteristic quantity in relation to the elasticity of an arterial canal wall, for example, as DI said that it was connected with the aperture of an arterial canal, i.e., the strain degree of an arterial canal. In this case, although the blood circulation moving state of a human body may only be judged from each characteristic quantity in a certain time, based on a time change of each characteristic quantity, the blood circulation moving state of a human body may be judged, for example, the blood circulation moving state of a human body may be judged based on the trend of the time series data of each characteristic quantity, the frequency-analysis result of time series data, the grade of fluctuation, chaos nature, etc. thus -- if it carries out, while calculating blood pressure based on each characteristic quantity -- the blood circulation moving state of the human body like for example, the degree of arteriosclerosis -- judging -- a judgment result -- blood pressure -- simultaneously, it can display, the circulatory system of a human body can be evaluated synthetically, and it is useful to healthy management etc.
[0105]
[Effect of the Invention] As explained above, in order that the blood-pressure-measurement equipment concerning the claim 1 of this invention may calculate the characteristic quantity relevant to blood pressure and may calculate blood pressure based on the calculated characteristic quantity from the detected pulse wave signal, While the complicatedness

of the operation of only a pulse wave sensor in the case of blood pressure measurement of the sensor with which a human body is equipped is lost, and prolonged run measurement also becomes possible and being able to improve user-friendliness In order to calculate the characteristic quantity relevant to blood pressure and to measure blood pressure, even if a pulse wave configuration changes, it is effective in the ability to measure blood pressure with a sufficient precision.

[0106] Moreover, the blood-pressure-measurement equipment concerning a claim 2 is effective in the ability of the pulse wave amendment section to measure blood pressure with a precision sufficient irrespective of the size of a pulse for a pulse wave signal at intervals of a pulse wave for an amendment reason.

[0107] Pulse wave characteristic quantity operation part the blood-pressure-measurement equipment concerning a claim 3 Moreover, each wave height of a pulse wave signal, In order that at least one of the ratio of each aforementioned wave height, the time from a pulse wave standup point to each aforementioned wave, the time interval between each aforementioned wave, the integration value of a pulse wave, and the pulse rates may be calculated as pulse wave characteristic quantity and a blood-pressure operation means may calculate blood pressure based on pulse wave characteristic quantity, Even if it becomes high blood pressure and arteriosclerosis and a pulse wave configuration changes, it is effective in the ability to measure blood pressure with a sufficient precision.

[0108] Moreover, the blood-pressure-measurement equipment concerning a claim 4 calculates the speed pulse wave whose speed pulse wave operation part is the primary differential of a pulse wave. Speed pulse wave characteristic quantity operation part Each wave height of a speed pulse wave signal, the ratio of each aforementioned wave height, the time from the speed pulse wave standup point describing above to each aforementioned wave, In order that at least one of the time interval between each aforementioned wave and the zero cross intervals of the aforementioned speed pulse wave may be calculated as speed pulse wave characteristic quantity and a blood-pressure operation means may calculate blood pressure based on speed pulse wave characteristic quantity, even if it becomes high blood pressure and arteriosclerosis and a pulse wave configuration changes, it is effective in the ability to measure blood pressure with a sufficient precision.

[0109] Moreover, the blood-pressure-measurement equipment concerning a claim 5 calculates the acceleration pulse wave which is the secondary differential of a pulse wave based on the pulse wave signal with which acceleration pulse wave operation part is outputted from a pulse wave detection means. In order that acceleration pulse wave characteristic quantity operation part may calculate at least one of each wave height of an acceleration pulse wave signal, the ratio of each aforementioned wave height, and the time intervals between each aforementioned wave as acceleration pulse wave characteristic quantity and a blood-pressure operation means may calculate blood pressure based on acceleration pulse wave characteristic quantity, Even if it becomes high blood pressure and arteriosclerosis and a pulse wave configuration changes, it is effective in the ability to measure blood pressure with a sufficient precision.

[0110] Moreover, as for the blood-pressure-measurement equipment concerning a claim 6, a pulse wave detecting element detects the pulse wave of the part of a human body which is different from each other. In order that pulse wave propagation characteristic quantity operation part may calculate at least one of the pulse wave propagation time and the pulse wave velocity as pulse wave propagation characteristic quantity based on a pulse wave signal and a blood-pressure operation means may calculate blood pressure based on pulse wave propagation characteristic quantity, While there is no complicatedness of wearing like an electrocardio grade electrode, pulse wave propagation characteristic quantity can be calculated and user-friendliness improves, even if it becomes high blood pressure and arteriosclerosis and a pulse wave configuration changes, it is effective in the ability to measure blood pressure with a sufficient precision.

[0111] Moreover, the blood-pressure-measurement equipment concerning a claim 7 is effective in the ability to measure blood pressure with a sufficient precision, when practicality can be raised, since a blood-pressure operation means calculates blood pressure based on the body characteristic quantity inputted into the body characteristic quantity input section.

[0112] Moreover, in order that a blood-pressure operation means may calculate blood pressure based on at least one of pulse wave characteristic quantity, speed pulse wave characteristic quantity, acceleration pulse wave characteristic quantity, pulse wave propagation characteristic quantity, and the body characteristic quantity, even if the blood-pressure-measurement equipment concerning a claim 8 becomes high blood pressure and arteriosclerosis and changes a pulse wave configuration, it is effective in the ability to measure blood pressure with a sufficient precision.

[0113] Moreover, since the blood-pressure-measurement equipment concerning a claim 9 can amend a relation with the blood pressure calculated with the inputted reference value with at least one of pulse wave characteristic quantity, speed pulse wave characteristic quantity, acceleration pulse wave characteristic quantity, pulse wave propagation characteristic quantity, and the body characteristic quantity, For example, when it can respond even if there is change of a user's blood circulation moving state by aging, body change, movement, posture change, etc. or a user changes, and

practicality can be raised, it is effective in the ability to measure blood pressure with a sufficient precision.
[0114] Moreover, since it comes to output the blood pressure corresponding to the characteristic-quantity information from a characteristic-quantity operation means even when the blood-pressure-measurement equipment concerning a claim 10 learns gradually the relation of the characteristic-quantity information and the reference-value signal of the blood pressure from the reference-value input section which are acquired from the characteristic-quantity signal from a characteristic-quantity operation means on the spot and finally has no amendment by the input of a reference value, it is effective in the precision of blood pressure measurement improving.
[0115] Moreover, since a pulse wave detection means can equip at least one part of the digiti-manus point, an earlobe, the digiti-pedis point, an overarm, a wrist, regions of neck, and a thorax with the blood-pressure-measurement equipment concerning a claim 11 and any part can detect a pulse wave easily, it is effective in the ability to improve user-friendliness.
[0116] Moreover, since the 1st pulse wave detecting element and the 2nd pulse wave detecting element adjoin, the blood-pressure-measurement equipment concerning a claim 12 can attain a miniaturization, and is effective in being convenient to carry.
[0117] Moreover, since both light-emitting parts are shared, the blood-pressure-measurement equipment concerning a claim 13 can perform curtailment of parts, and is effective in practicality being high.
[0118] Moreover, since the blood-pressure-measurement equipment concerning a claim 14 detects a pressure pulse wave from regions of neck or a thorax and can detect a pulse wave from a pressure sensor in the position near the heart, it is effective in the ability to improve the pulse wave propagation time and the operation precision of pulse wave velocity.
[0119] Moreover, since the blood-pressure-measurement equipment concerning a claim 15 detects the vibration and the heart sound by the beat of the heart with a microphone, it is effective in the ability to improve the pulse wave propagation time and the operation precision of pulse wave velocity.
[0120] Moreover, since it is reproducible with a blood-pressure operation means at any time, the trend of the decision value from the past etc. understands the value the blood-pressure-measurement equipment concerning a claim 16 was remembered to be, and it is effective in being user-friendly.
[0121] Moreover, the blood-pressure-measurement equipment concerning a claim 17 can display the display of real time, and the memorized past data at any time, and is effective in being user-friendly.
[0122] Moreover, since the alarm generating section generates an alarm when the calculated blood pressure deviates from a normal range, the blood-pressure-measurement equipment concerning a claim 18 can check the abnormalities of the body under sleeping and work, and is effective in being useful to the health care.
[0123] In order that the blood-pressure-measurement equipment furthermore applied to a claim 19 may perform communication with an external medium through the terminal area for communication, it can perform renewal of the concentration health care in an external medium, or required information, and is effective in the ability to improve user-friendliness.

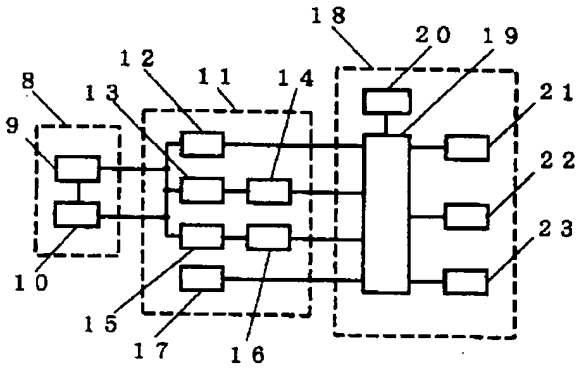
[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

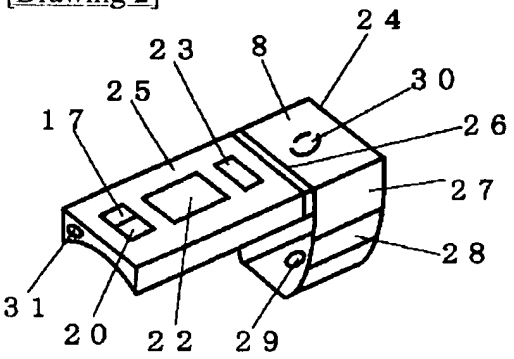
DRAWINGS

[Drawing 1]



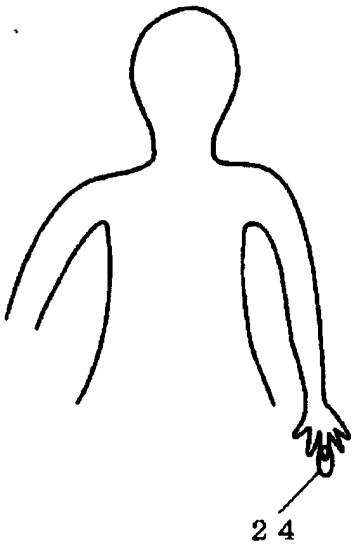
8 脈波検出手段
9 脈波検出部
10 脈波補正部
11 特徴量演算手段
12 脈波特徴量演算部
13 速度脈波演算部
14 速度脈波特徴量演算部
15 加速度脈波演算部
16 加速度脈波特徴量演算部
17 身体特徴量入力部
18 血圧演算手段
19 血圧演算部
20 基準値入力部
21 記憶部
22 表示部
23 警報発生部

[Drawing 2]

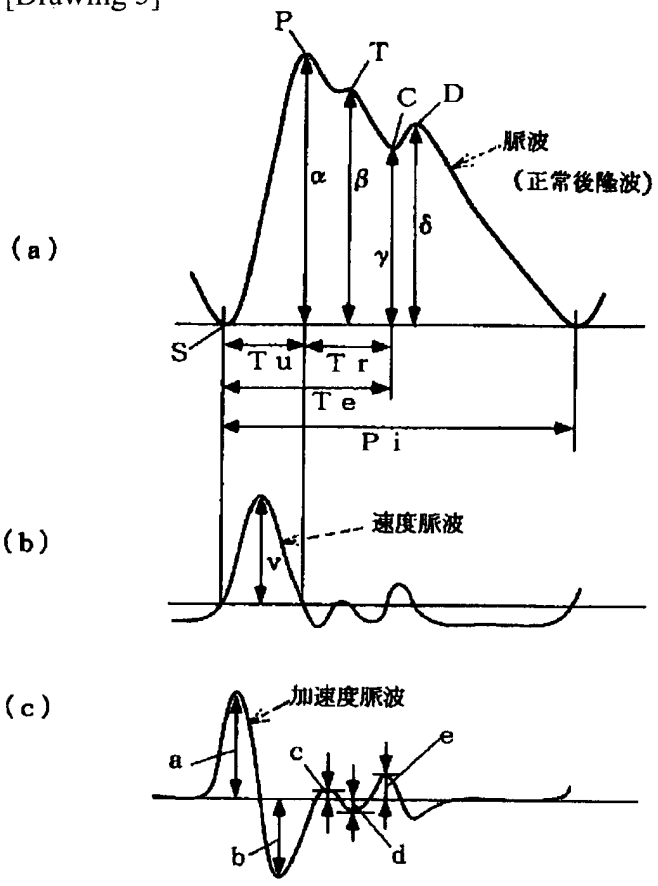


24 本体
25 信号処理ユニット
26 接続部
27 挿入部
28 伸縮部
29 第1の発光部
30 第1の受光部
31 通信用端子部

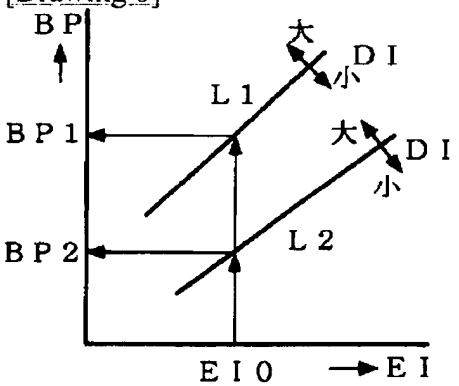
[Drawing 3]



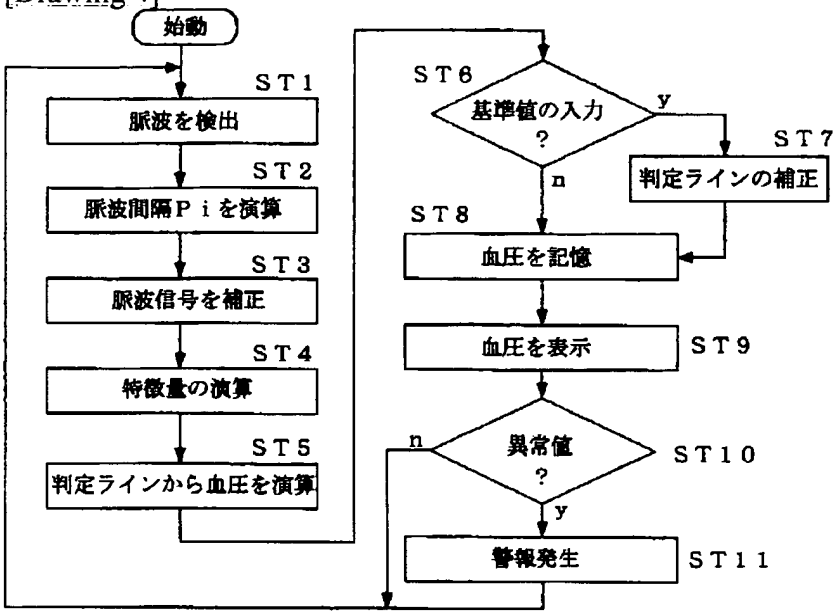
[Drawing 5]



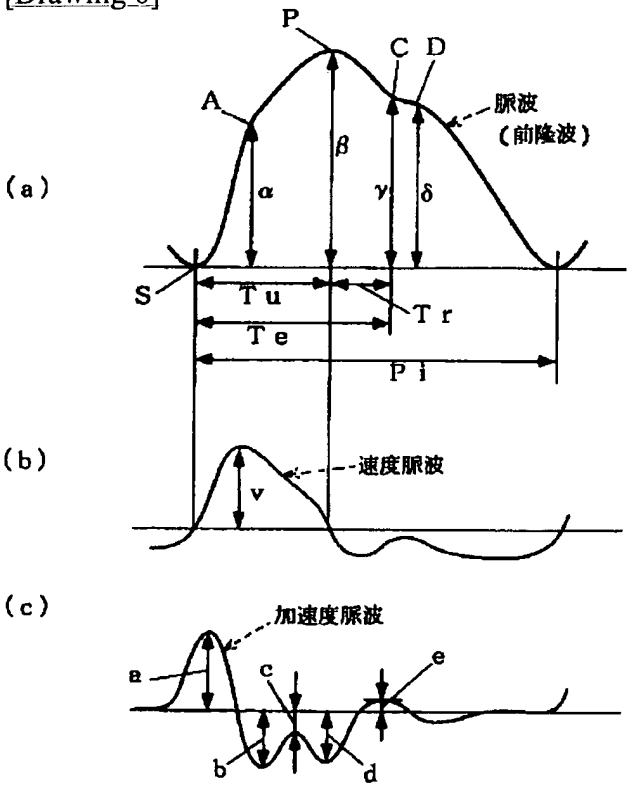
[Drawing 8]



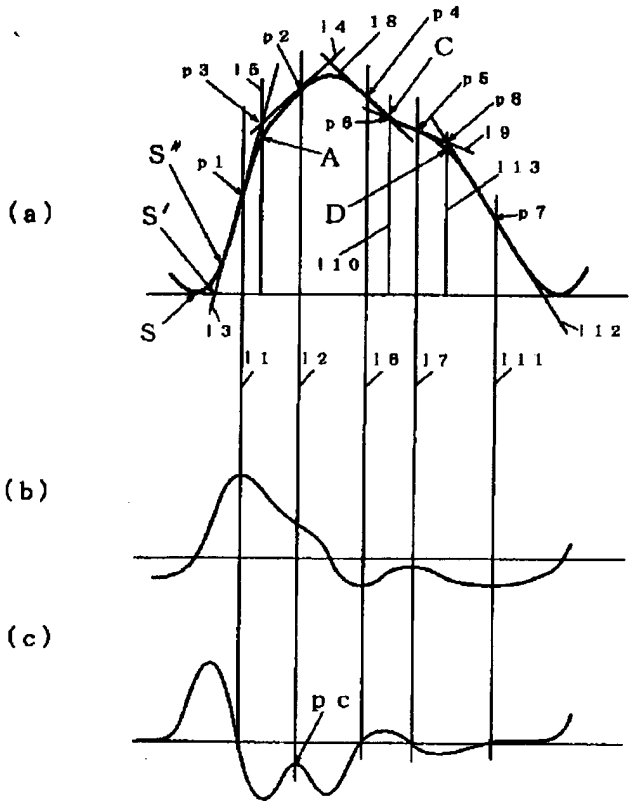
[Drawing 4]



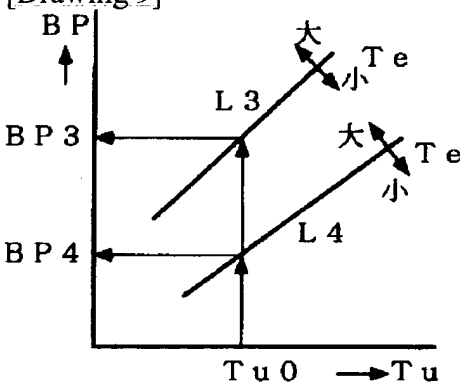
[Drawing 6]



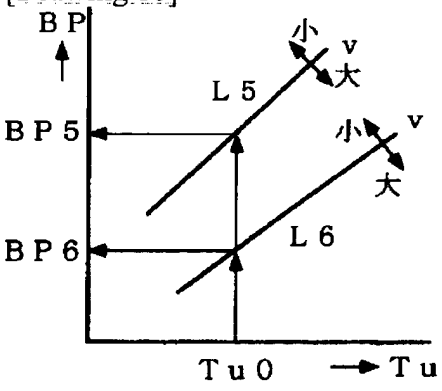
[Drawing 7]



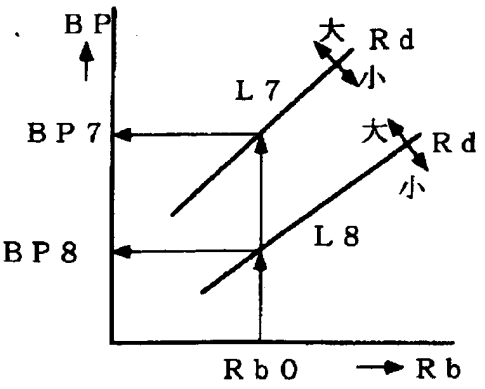
[Drawing 9]



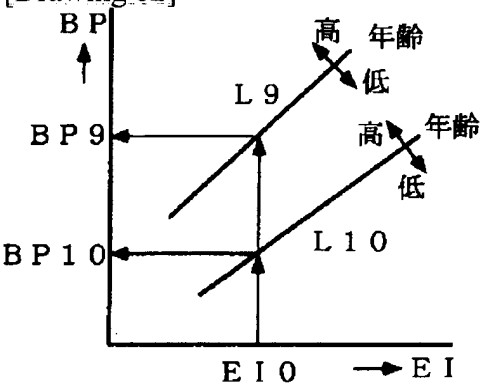
[Drawing 10]



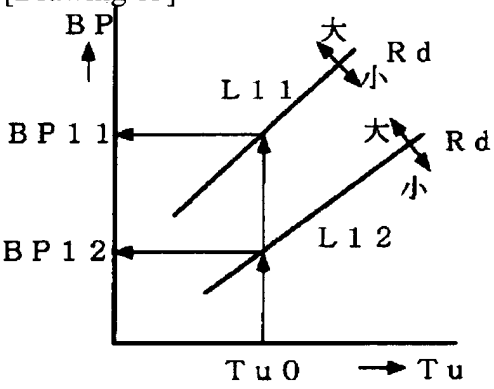
[Drawing 11]



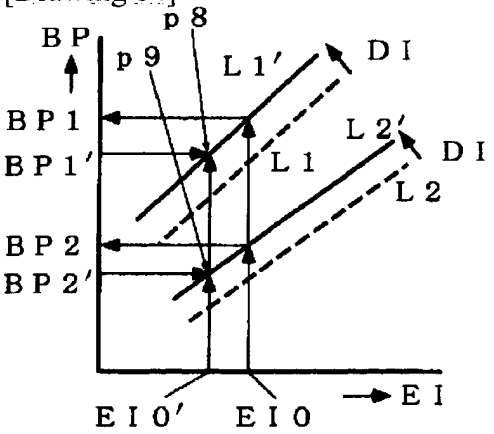
[Drawing 12]



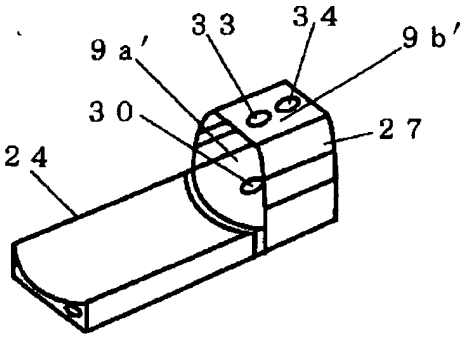
[Drawing 13]



[Drawing 14]



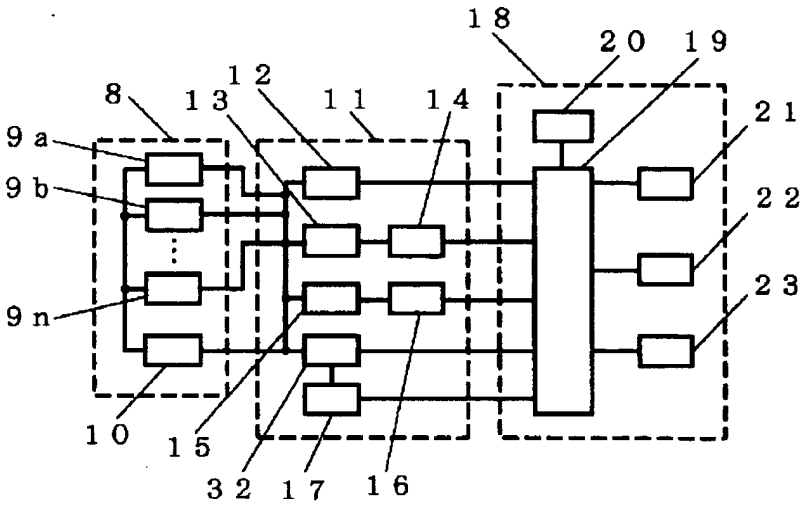
[Drawing 16]



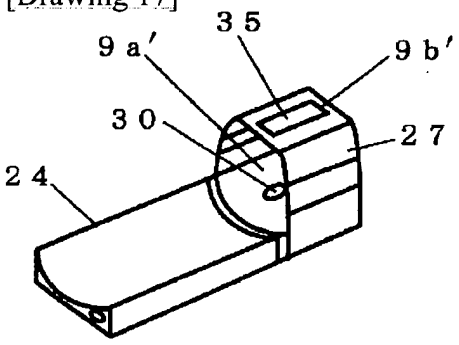
９ａ′ 第１の脈波検出部
９ｂ′ 第２の脈波検出部
３３ 第２の発光部
３４ 第２の受光部

[Drawing 15]

９ａ～９ｎ 脈波検出部
３２ 脈波伝播特徴量演算部

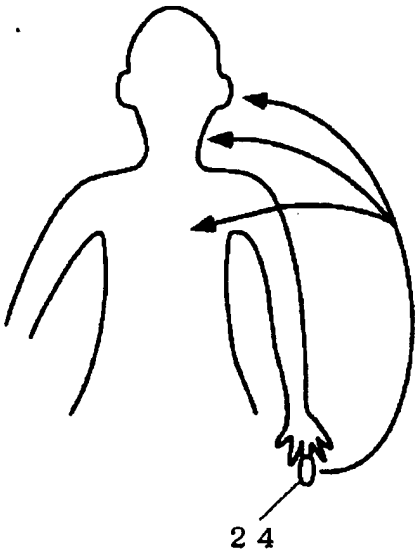


[Drawing 17]

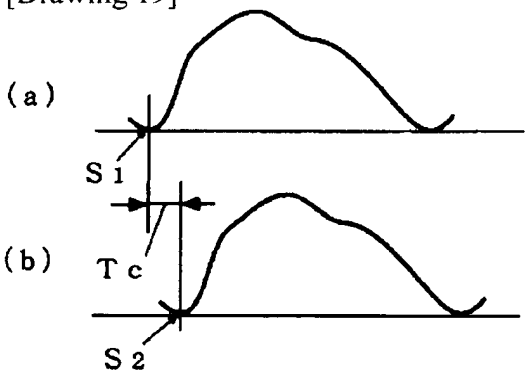


３５ 圧力センサ

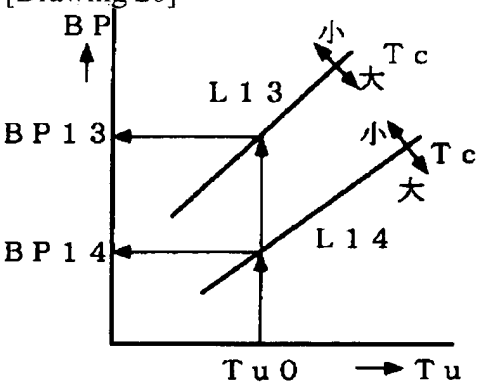
[Drawing 18]



[Drawing 19]



[Drawing 20]



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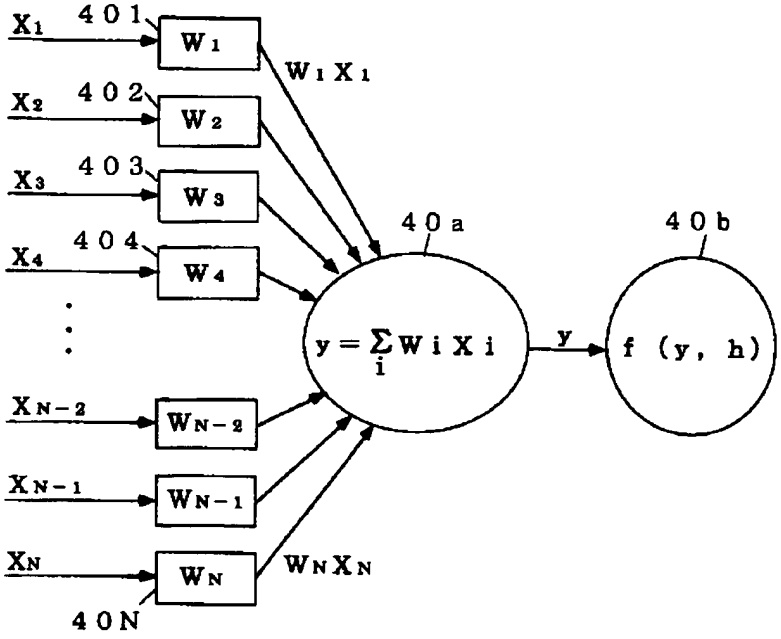
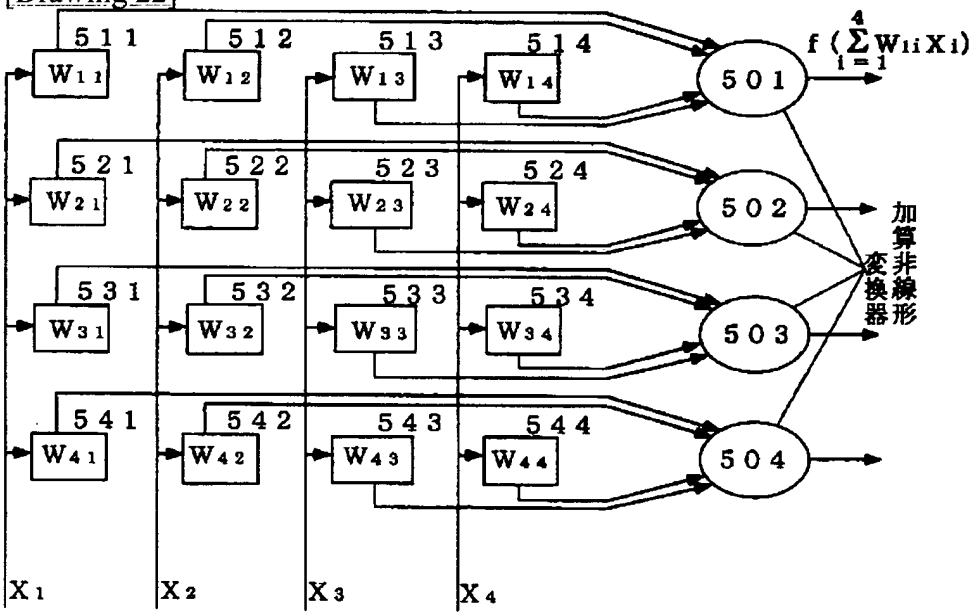


[Drawing 22]



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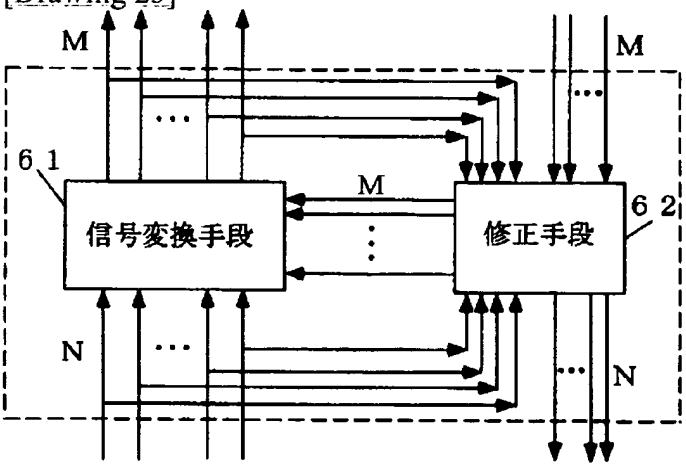

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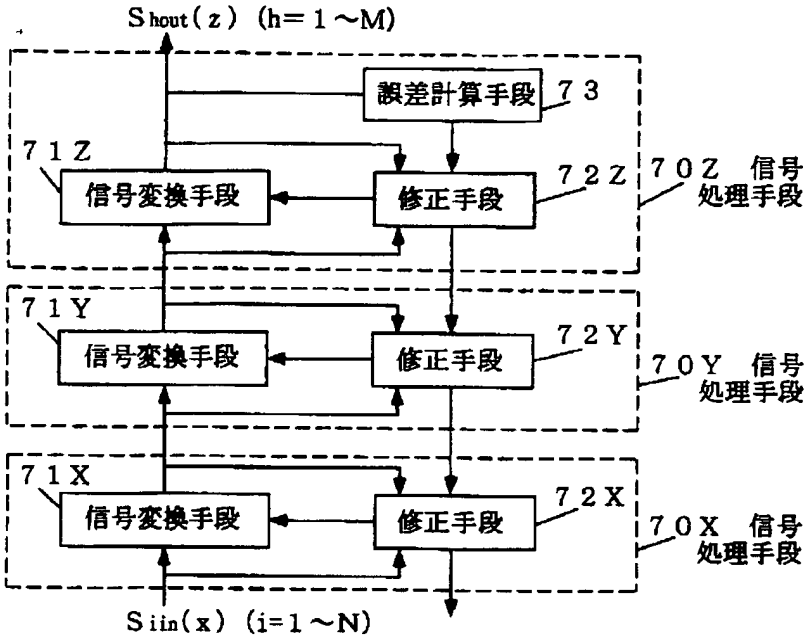
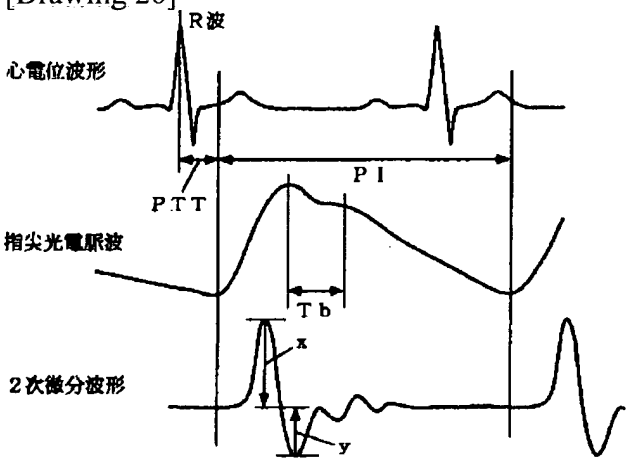


[Drawing 26]



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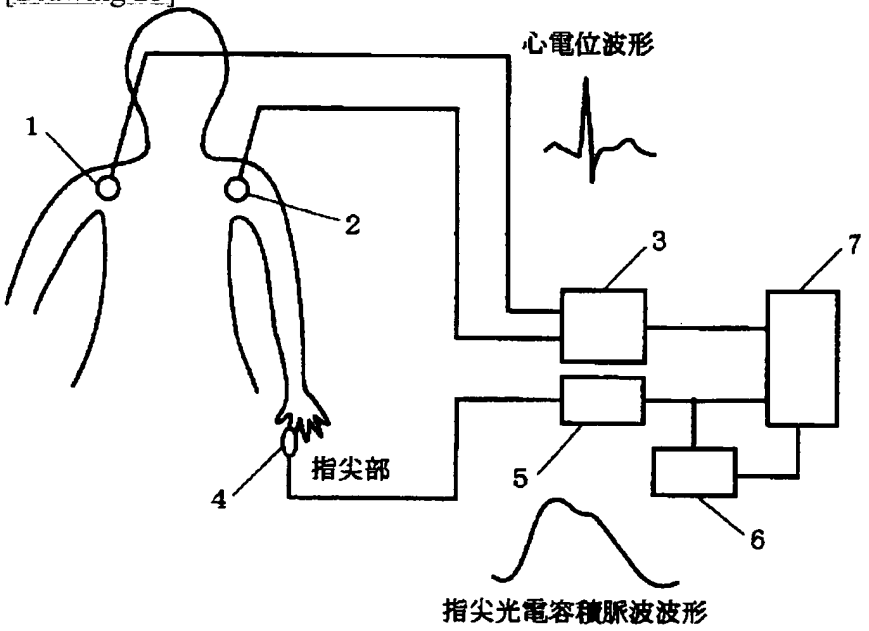

[Translation done.]